

{NASA-TM-77710} HIGH FREQUENCY-HEATED AIR  
TURBOJET {National Aeronautics and Space  
Administration} 12 p HC A02/MF A01 CSCL 21E

N86-21543

G3/07 Unclass  
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HIGH FREQUENCY-HEATED AIR TURBOJET

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Translation of "Turbo Reactor de Aire Calentado Por Alta Frecuencia",  
Spanish Patent Application no. 293,727, November 21, 1983, Zamora,  
Spain, pages 1-10.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON D.C. 20546 FEBRUARY 1986

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STANDARD TITLE PAGE

1. Report No. NASA TM-77710	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle HIGH FREQUENCY-HEATED AIR TURBOJET		5. Report Date FEBRUARY 1986	
		6. Performing Organization Code	
7. Author(s)  JUAN HELIODORO DIAZ MIRON		8. Performing Organization Report No.	
		10. Work Unit No.	
9. Performing Organization Name and Address SCITRAN Box 5456 Santa Barbara, CA 93108		11. Contract or Grant No. NASw 4004	
		13. Type of Report and Period Covered Translation	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		14. Sponsoring Agency Code	
15. Supplementary Notes  Translation of "Turbo Reactor de Aire Calentado por Alta Frecuencia", Spanish Patent Application No. 293,727, November 21, 1983, Zamora, Spain, pages 1 - 10.			
16. Abstract  A description is given of a method to heat air coming from a turbojet compressor to a temperature necessary to produce required expansion without requiring fuel. This is done by high frequency heating, which heats the walls corresponding to the combustion chamber in existing jets, by mounting high frequency coils in them. The current transformer and high frequency generator to be used are discussed.			
17. Key Words (Selected by Author(s))		18. Distribution Statement  Unclassified and Unlimited	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 12	22. Price

PATENT OF INVENTION  
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D E S C R I P T I V E   A C C O U N T

Concerning:

"HIGH FREQUENCY-HEATED AIR TURBOJET"

- - - - -

Applicant:    Don Juan Heliodoro DIAZ MIRON, of Spanish  
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Inventor:    The applicant.

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This descriptive account is for the purposes of establishing exclusive industrial and commercial use in the National territory under a Patent of Invention, in accordance with existing Patent Law, of the object described above, a high frequency-heated air turbojet. /2\*

Existing gas turbines and turbojets operate from the enormous expansion energy produced by the combustion of a petroleum derivative in a jet of air. Considerable fuel is required to produce the high temperatures which create the gas expansion projected at high velocity from the rear of the turbojet, thus providing the required thrust.

A means of heating the air coming through the compressor of the turbojet to the temperature necessary to produce the required

\*Numbers in margin indicate foreign pagination.

expansion without requiring fuel would have the advantage of eliminating the weight of on-board fuel and reduce the gas combustion contrails seen in existing turbojets.

The applicant has discovered how to achieve the necessary temperature increase by high frequency heating. This is done by heating the walls corresponding to the combustion chamber in existing jets, by mounting high frequency coils therein.

The parasitic, or Foucault currents created by high frequency induction produce heat around an electrical conductor, which is determined by the following equation:

$$H = C f_n I^2$$

where C is a constant determined by the material used, I the intensity of the current applied and f its frequency.

There are in existence electronic devices which can generate /3 intensities and frequencies of the type needed for this invention, making induction heating practicable at frequencies between 60 and 1,000,000 hertz.

To facilitate the most precise interpretation of the object which is to fall under this privilege, a diagram is attached to complement this description. A practical form of an industrial application is given purely as an example; it is in no way exhaustive, but merely informational.

Figure 1 of the diagram shows a turbojet unit in longitudinal section.

Figure 2 shows a basic schematic of the system activating the high frequency coils.

As shown on Figure 1, the turbojet 1 is made up of a tubular body with a cold air intake 2 and a hot air exhaust 3. Inside, there is a longitudinally oriented axle 5 mounted on bearings 6 and 7. Mounted on it, at the side of the intake 2 is a rotary air compressor 8 whose air output is supplied to an annular chamber 9 which has its inner circumference lined with high frequency coils 11 wound on metallic cores. The exhaust from these chambers strikes the fixed blades of the gas turbine 10. Thus the air entering the intakes 2 is first compressed in 8 and then heated in the annular chamber 9 by high frequency induction originated by the coils 11 and then, at high temperature and therefore greatly increased volume and the consequent increased velocity, it projects against the turbine 10 to exit the exhaust /4 3 after passing through the deflector 8 [sic].

The high velocity projection of air through the exhaust 3 originates a thrust or reaction similar to that of existing turbojets while the compressor 8 compresses the air as indicated.

As shown in Figure 2 the axle 5 is also connected to the direct current generator 13 which, through switch 14, supplies the storage battery 15 connected to the D.C.-A.C. converter and high frequency generator 12 which energizes the heating coils 11.

With the nature of the invention as well as its practical application sufficiently described, it remains only to add that the invention is susceptible to modifications and changes of

material, form and disposition, overall or in its constituent parts, without detracting from its basic essence.

The applicant reserves the right to extend this application to foreign countries, claiming the same priority as this application to the protection of the International Convention for Patent Protection.

Similarly, the applicant reserves the right to add to this Invention such improvements as may be derived, by means of applying for applicable Certificates of Addition as provided for by the Law.

#### N O T E

The Patent of Invention which for Spain, is requested for twenty years, in accordance with the laws in force, should protect the "HIGH FREQUENCY-HEATED AIR TURBOJET", according to the essential characteristics of the following:

#### C L A I M S

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1. High frequency-heated air turbojet, characterized by admission and compression of cold air by a compressor mounted on the turbine axle, after which it is projected at high pressure into a chamber containing high frequency coils energized by a high frequency generator, enabling them to heat the incoming air sufficiently to produce a large increase in its volume, projecting it at a high velocity into a gas turbine mounted upon the same axle as the compressor, the axle being coupled in turn, to a direct current generator, charging a storage battery which

powers a converter-high frequency generator assembly during start-up and as a compensator in normal operation, for energizing the said coils.

## 2. HIGH FREQUENCY-HEATED AIR TURBOJET.

As substantially described in this descriptive account, which consists of five sheets, typewritten on only one side, and drawings.

Madrid, November 21, 1963

Don JUAN HELIODORO DIAZ MIRON

P.P.

FRANCISCO GARCIA CABRERO

CALCULATION OF THE POWER NECESSARY TO HEAT AN AIR FLOW OF 14 X 75 LITERS/HOUR FROM AN AMBIENT TEMPERATURE OF 18°C TO 1,000°C.

Assuming that the air mass after combustion [sic] remains at the ambient temperature (recognizing that it warms up with compression, and to learn this temperature, one must know the compression ratio), we can say with a reasonable degree of approximation that the calorific power required is that to raise the temperature from the 18° C. ambient level to 1,000°C.

For an exact calculation, we could use the energy equation of systems in permanent flux, but as we don't have very precise data, we might also use the following:

$$Q = \int_{T_1}^{T_2} n C_V dT \quad (1)$$

n = number of moles

The flow rate in moles/liter would be:

Air contains approximately 20% O<sub>2</sub> and 80% N<sub>2</sub>

$$\text{Air flow rate} = \frac{14 \times 75}{3,600} = 0.292 \text{ l/sec}$$

The number of moles contained in one liter of air at 18°C and at one atmosphere of pressure is:

$$P V = n R T; \quad n = \frac{P V}{R T} = \frac{1}{8,2 \times 10^{-2} \times 291} = 4,19 \times 10^{-2} \text{ moles}$$

$$\text{Flow rate of O}_2 = (4,19 \times 10^{-2} \times 0,292) \frac{20}{100} = 2,445 \times 10^{-3}$$

$$\text{Flow rate of N}_2 = (4,19 \times 10^{-2} \times 0,292) \frac{80}{100} = 9,780 \times 10^{-3}$$



Molar heats at V = Qt. of N<sub>2</sub> and O<sub>2</sub>

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$$C_V O_2 = 4,148 + 0,003 T$$

$$C_V N_2 = 4,524 + 0,0012 T$$

Let us now apply equation (1)

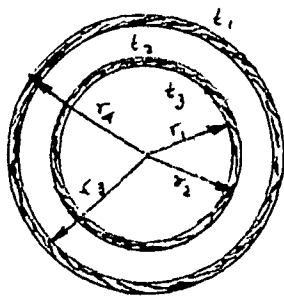
$$\begin{aligned}
 Q &= 2,445 \times 10^{-3} \int_{291}^{1273} (4,148 + 0,003 T) dT + \\
 &\quad + 9,780 \times 10^{-3} \int_{291}^{1273} (4,524 + 0,0012 T) dT = \\
 &= 2,445 \times 10^{-3} (4,060 + 2,371) + 9,760 \times 10^{-3} (4,430 + 924) = \\
 &= 2,445 \times 6,371 + 9,760 \times 5,354 = 15,58 + 52,4 = 67,98 \text{ cal.} \\
 \underline{Q} &= \underline{67.98 \text{ calories}}
 \end{aligned}$$

T represents absolute temperatures, and so the limits of integration are not centigrade, but absolute.

Once we know the heat, the power necessary to heat the stated flow is:

$$\frac{Q}{t} = \frac{67.98 \text{ cal}}{\text{sec}}$$

The heat losses in the annular chamber might be calculated by:



$$q = \left[ \frac{2\pi k (t_2 - t_1)}{\ln \frac{r_4}{r_3}} + \frac{2\pi k (t_2 - t_3)}{\ln \frac{r_2}{r_1}} \right] L$$

Where:

r and t are the indicated radii

L = length of ring

k = heat transmission coefficient of the material

These would be the most important heat conduction losses, and if the material used to make the annular chamber is refractory enough, we could have heat losses in the order of 10%, /3 requiring the provision of heat to the coils of:

$$Q - \frac{Q}{10} = 67.98; \quad Q = 75.4 \text{ cal/sec} = 75.4 \times 4.184 \text{ joules/sec} =$$

315.5 joules/sec, since the calories Q are equivalent to joules multiplied by J, the mechanical equivalent of heat, which is equal to 4.184.

The dynamo, then, would have to supply this energy plus that of any line losses across the entire electric circuit.

Taking into account the losses of the current converter and those in the battery circuit, total losses may be 20%, bringing the required dynamo power to:

$$315.5 = P - \frac{20}{100} P; \quad P = 394 \text{ joules/sec.}$$

$$P = 394 \text{ joules/sec} = \frac{394}{9.8 \times 75} = .536 \text{ H P} \quad P = 394 \text{ w}$$

$$\underline{P = 394 \text{ watts}}$$

As we can see, the power is small, but so is the flow we are considering. If the latter were greater, our problem would be to modify the data using the same procedure, and the required work capacity of the dynamo, which plays the most important role in heating the air, would be greater.

Battery capacity is a different and secondary problem, which can be taken care of by viewing it as a current carrier, since

the current heating the coils after conversion to A.C. is no greater than the D.C. supplied by the dynamo.

#### Current Transformer.

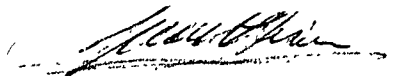
The current transformer must have a great many cycles per second, and in this case, an oscillator is suitable. The THYRATRON can also be used.

#### High Frequency Generator.

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The MAGNETRON can be used. It is a VHF generator whose oscillations depend on the external circuit or the transit time of the electrons.

Navaconsejo, July 1, 1964

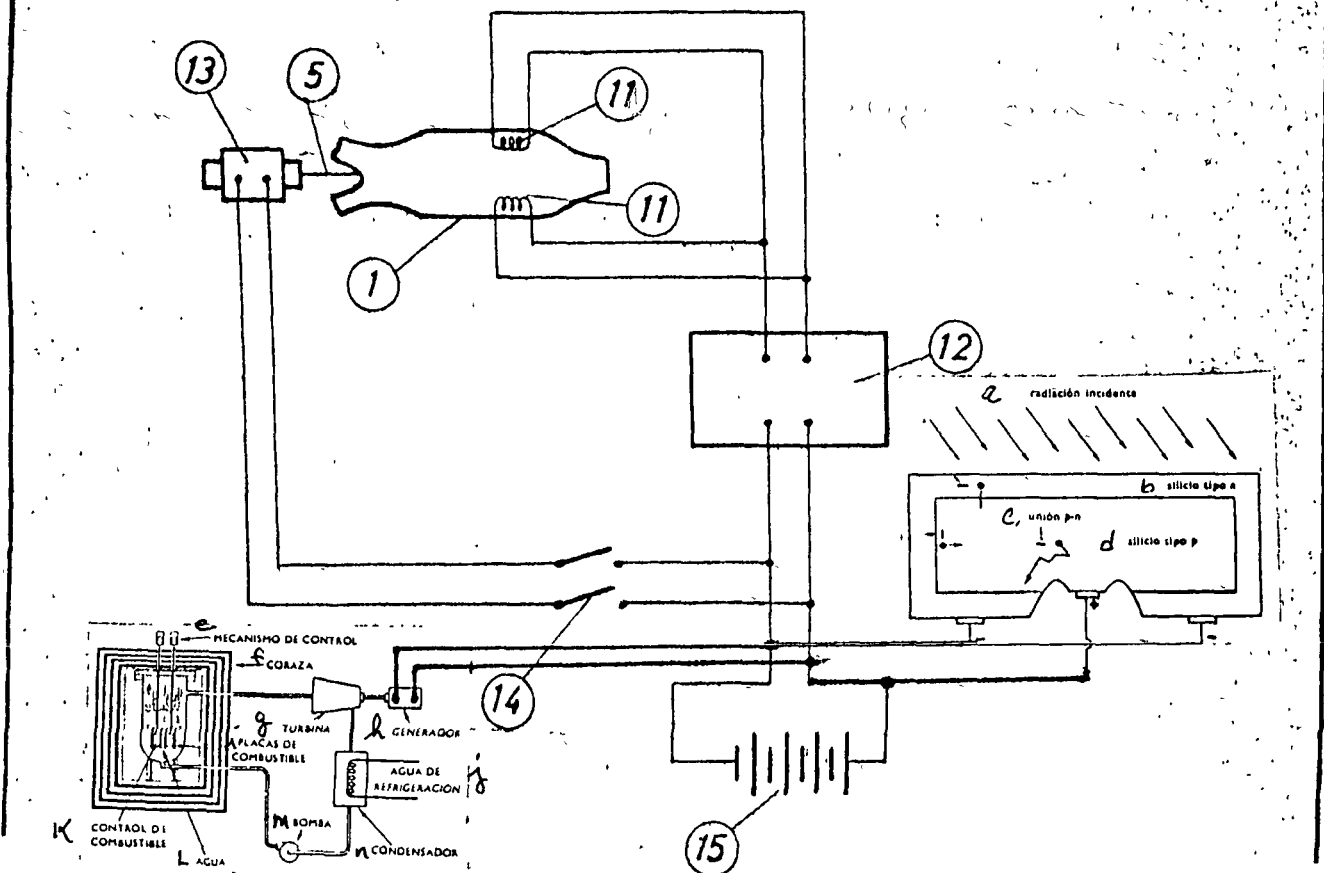
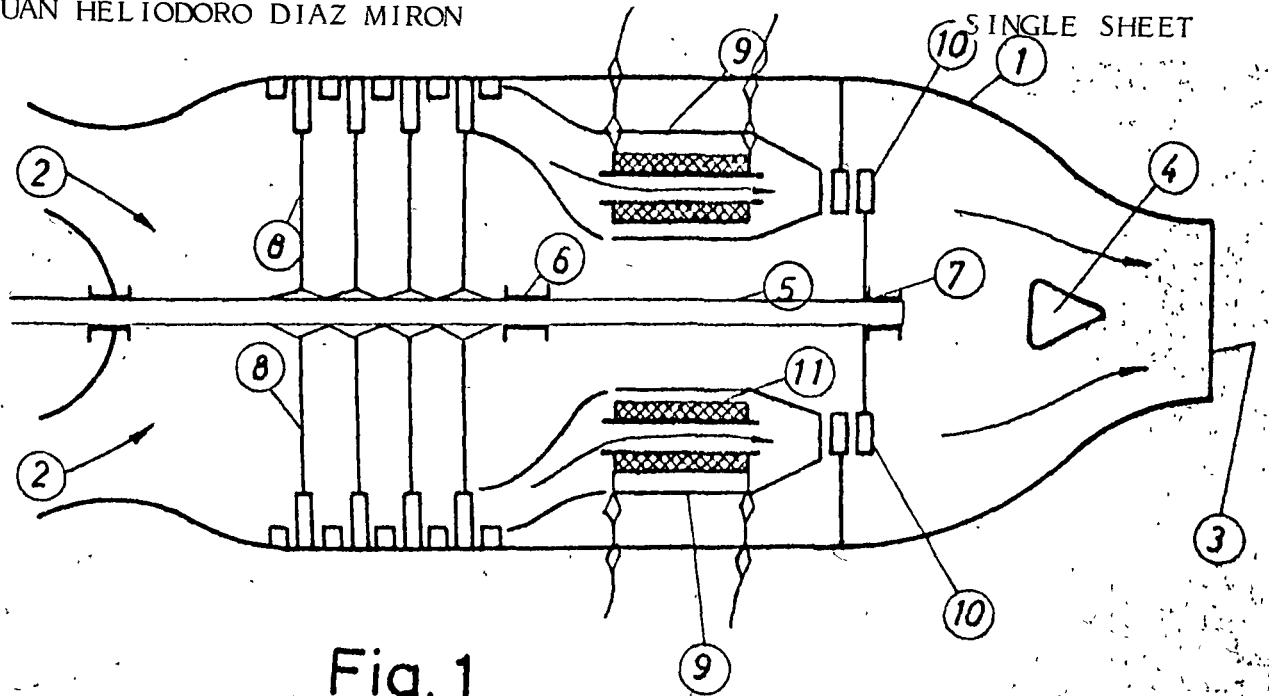


Signed: Juan Heliodoro Díaz Mirón

Key for words used on drawing (next page):

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|-----------------------|--------------------|
| a. incident radiation | k. fuel switch     |
| b. type n silicon     | l. water           |
| c. p-n jointure       | m. pump            |
| d. type p silicon     | n. condenser       |
| e. control mechanism  | o. NUCLEAR REACTOR |
| f. shield             |                    |
| g. turbine            |                    |
| h. generator          |                    |
| i. fuel plates        |                    |
| j. cooling water      |                    |

JUAN HELIODORO DIAZ MIRON



Zamora, January 1985

JUAN HELIODORO DIAZ MIRON